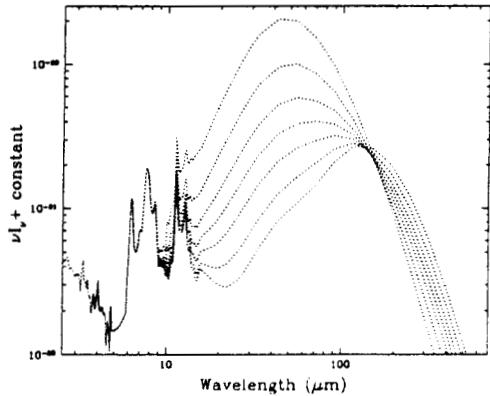


The Infrared Spectral Energy Distribution of Normal Galaxies

Daniel Dale
California Institute of Technology
2000



Collaborators from the US-ISO Normal Galaxy Key Project team:

George Helou (Caltech)

Alessandra Contursi

Nancy Silbermann

Sonali Kolhatkar

Synthetic Infrared Spectra of Normal Galaxies

- Empirical Evidence

- ISO Mid-Infrared Spectroscopy
- Broad band fluxes at 7, 12, 15, 25, 60, 100 μm
- IRAS color-color diagram
- ISO-IRAS color-color diagram

- Model dust emission using distribution over heating intensities U :

$$dM_d(U) \propto U^{-\alpha} dU$$

At each U , the spectrum is derived using 3 dust components

- Aromatics
- Very Small Grains
- Large classical grains in thermal equilibrium, $\epsilon \propto \lambda^{-2}$

- To approach a good fit to the data, one needs:

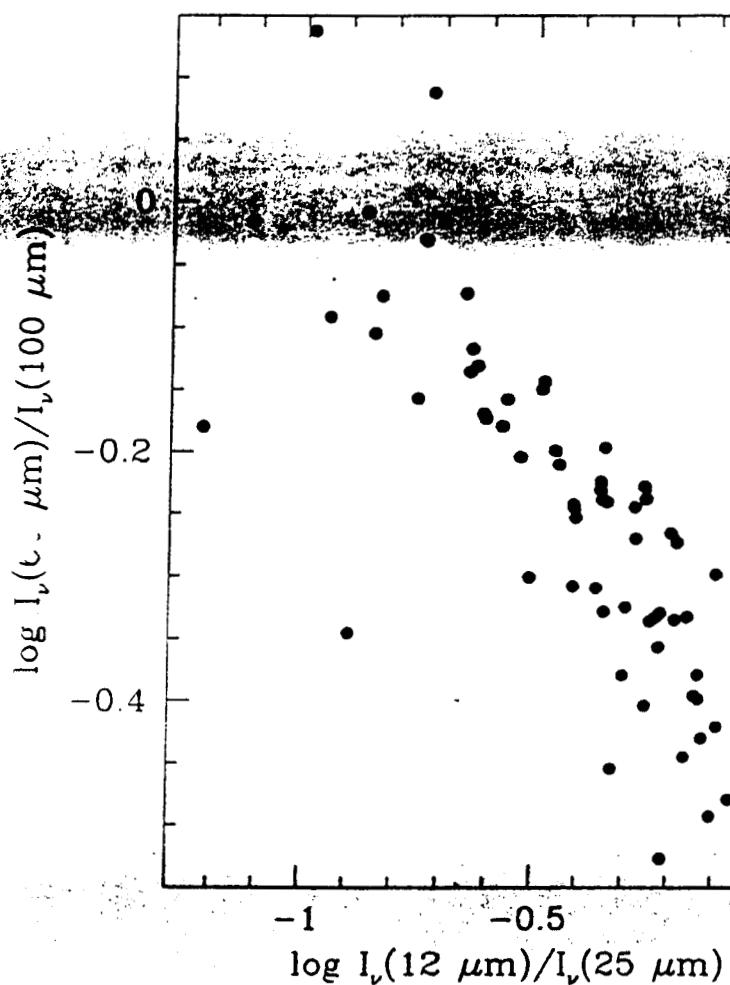
- Ratio of aromatics to large grains drops as U increases
- VSG spectrum is narrower and peaks at shorter λ as U increases

Draine & Anderson (1985) for physically plausible dependence

As U increases, approach limit of mild fluctuations, $\Delta T/T \approx 1$

Infrared Color-Color Diagrams

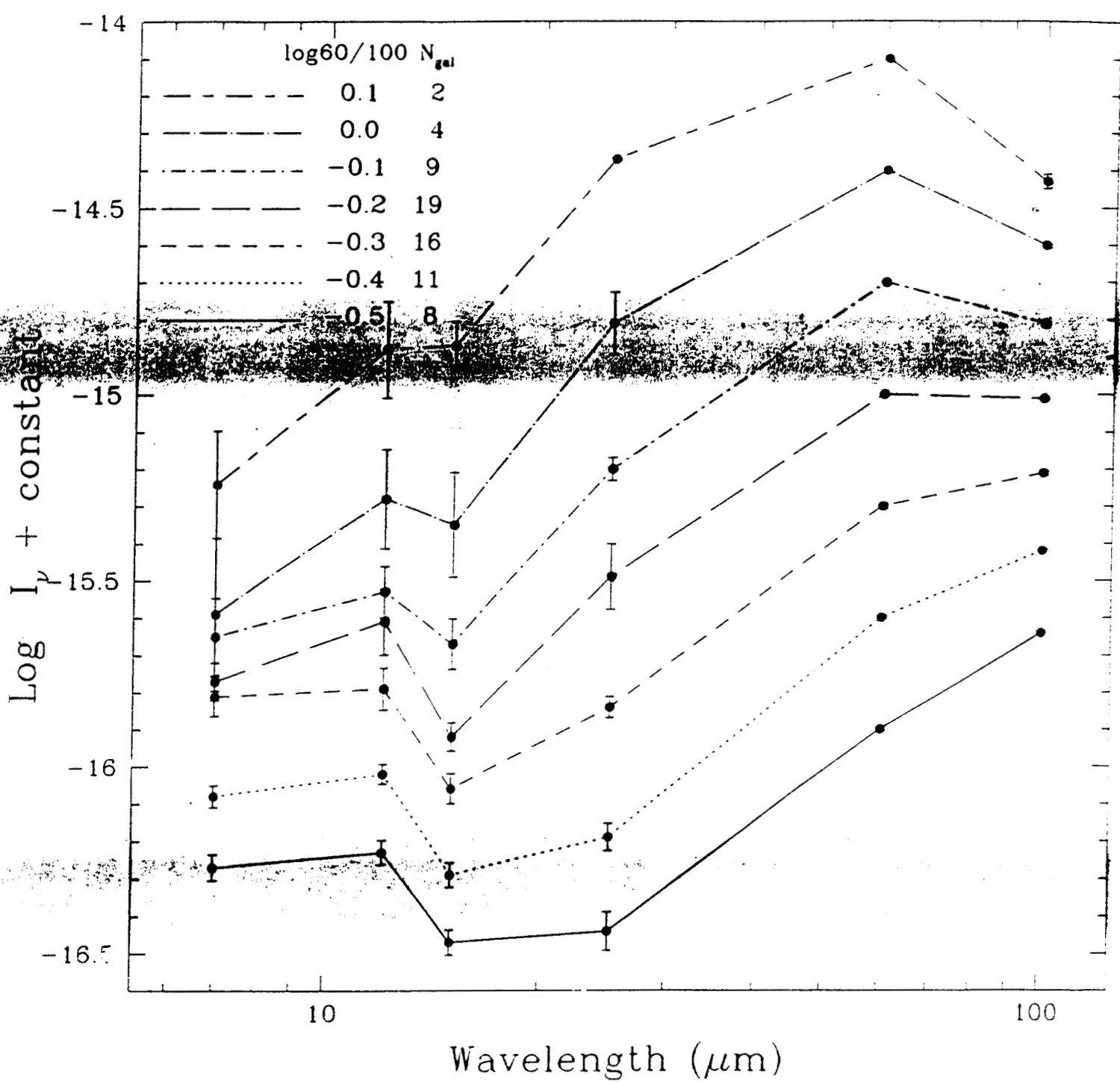
IRAS-IRAS



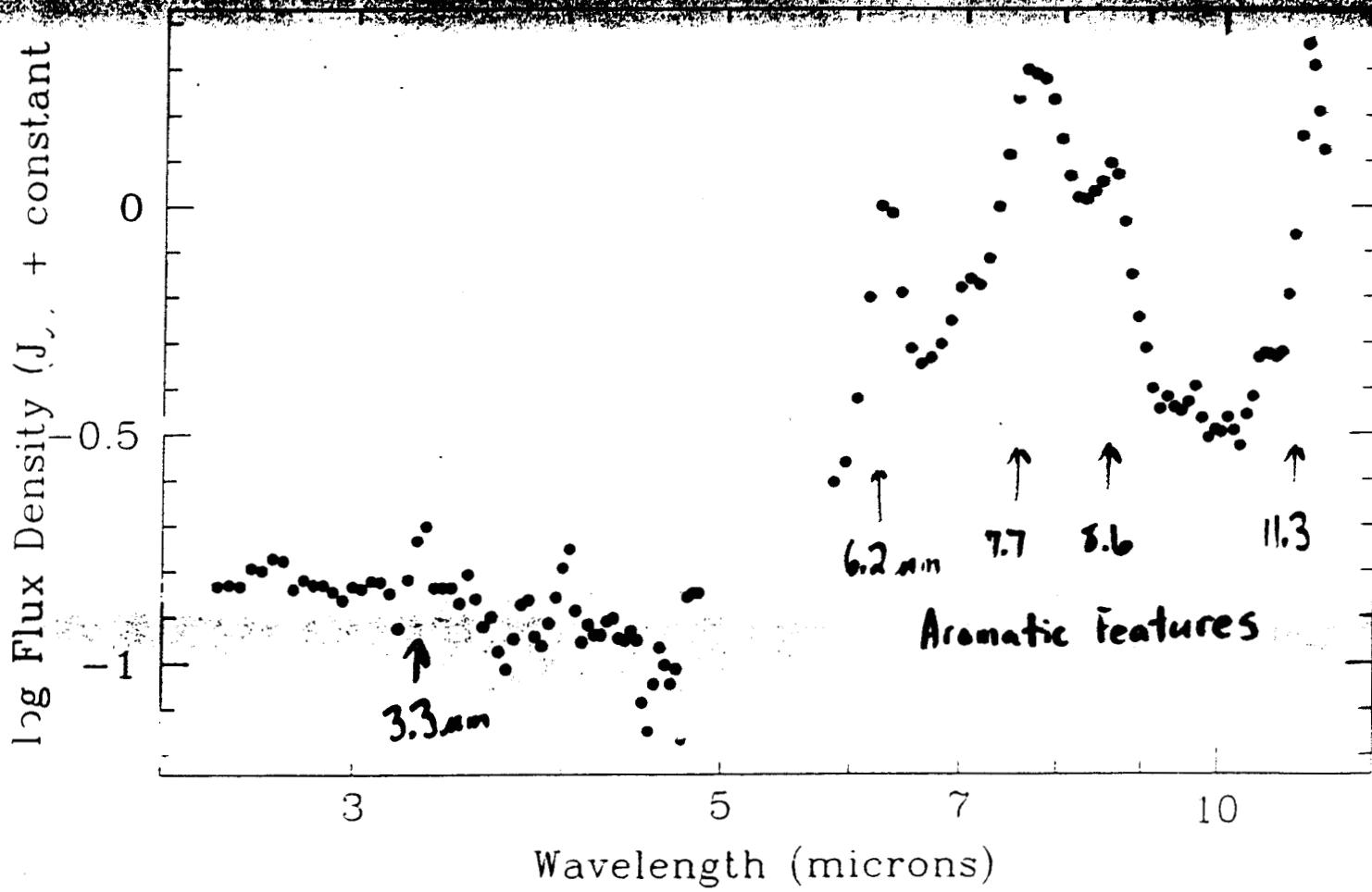
IRAS-150



Synthetic Empirical Spectra



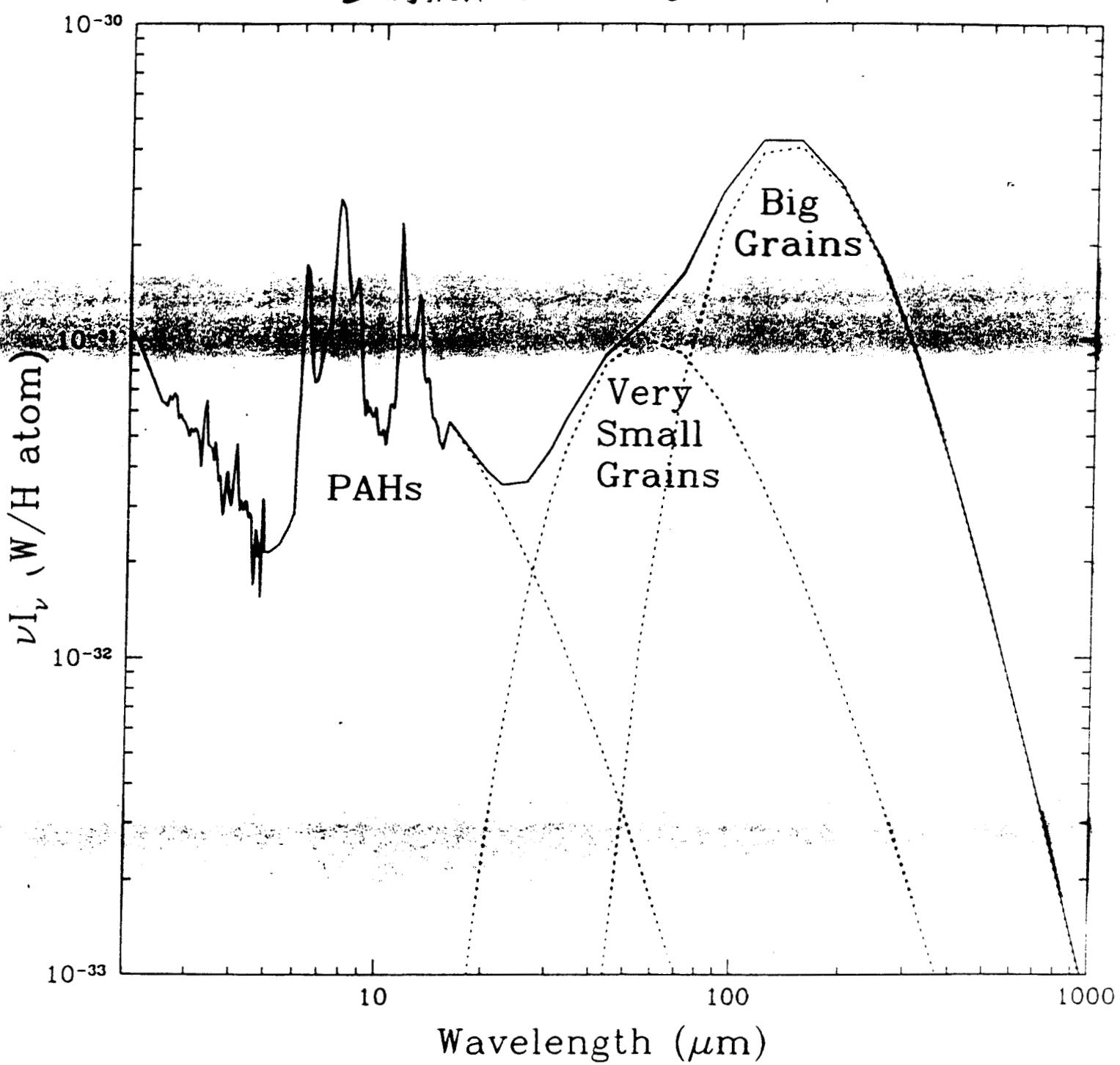
Average of ~38 Normal Galaxy PHT-S spectra

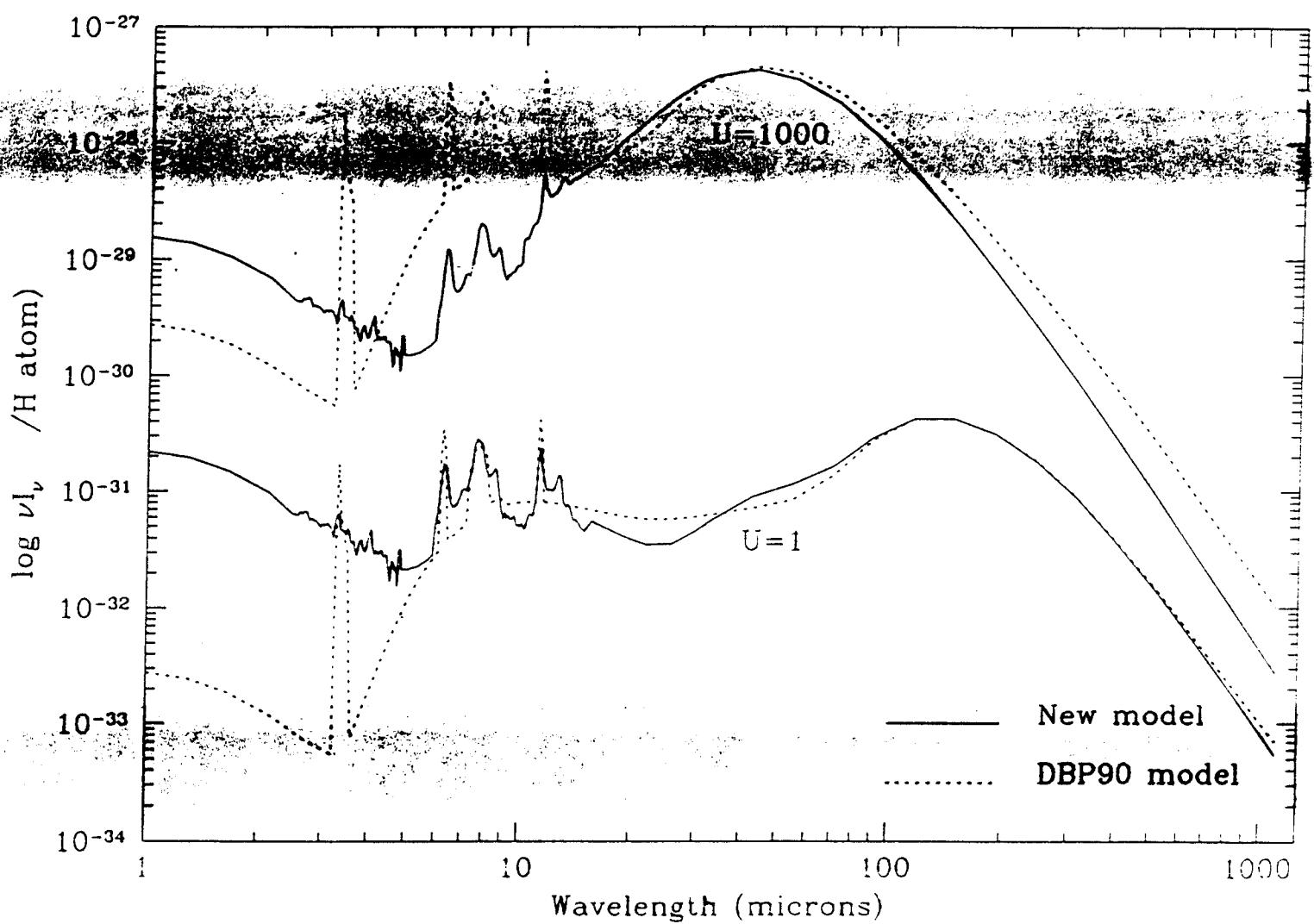


Hebb et al (2000)
ApJ Letters
in press

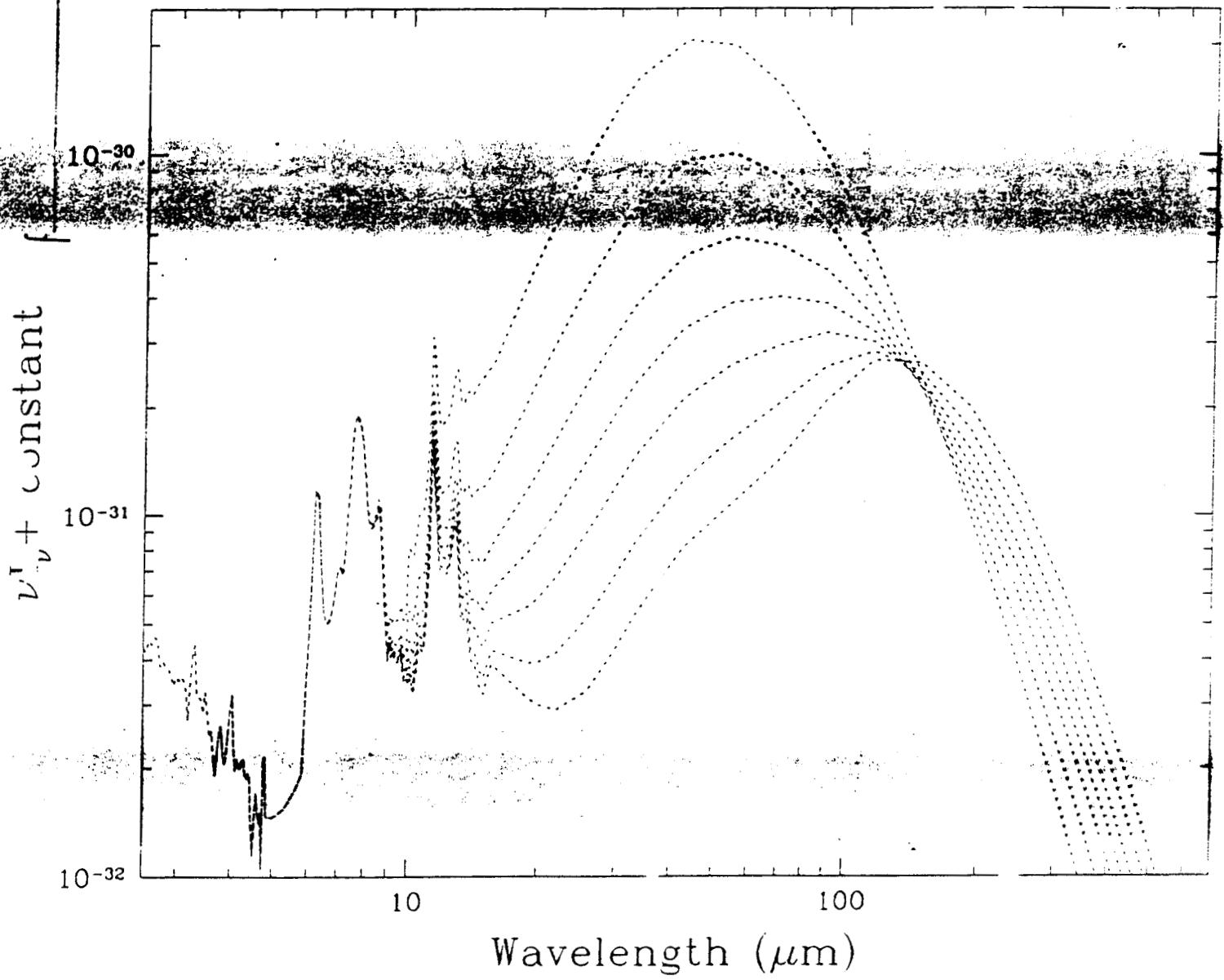
Three Component Dust Model

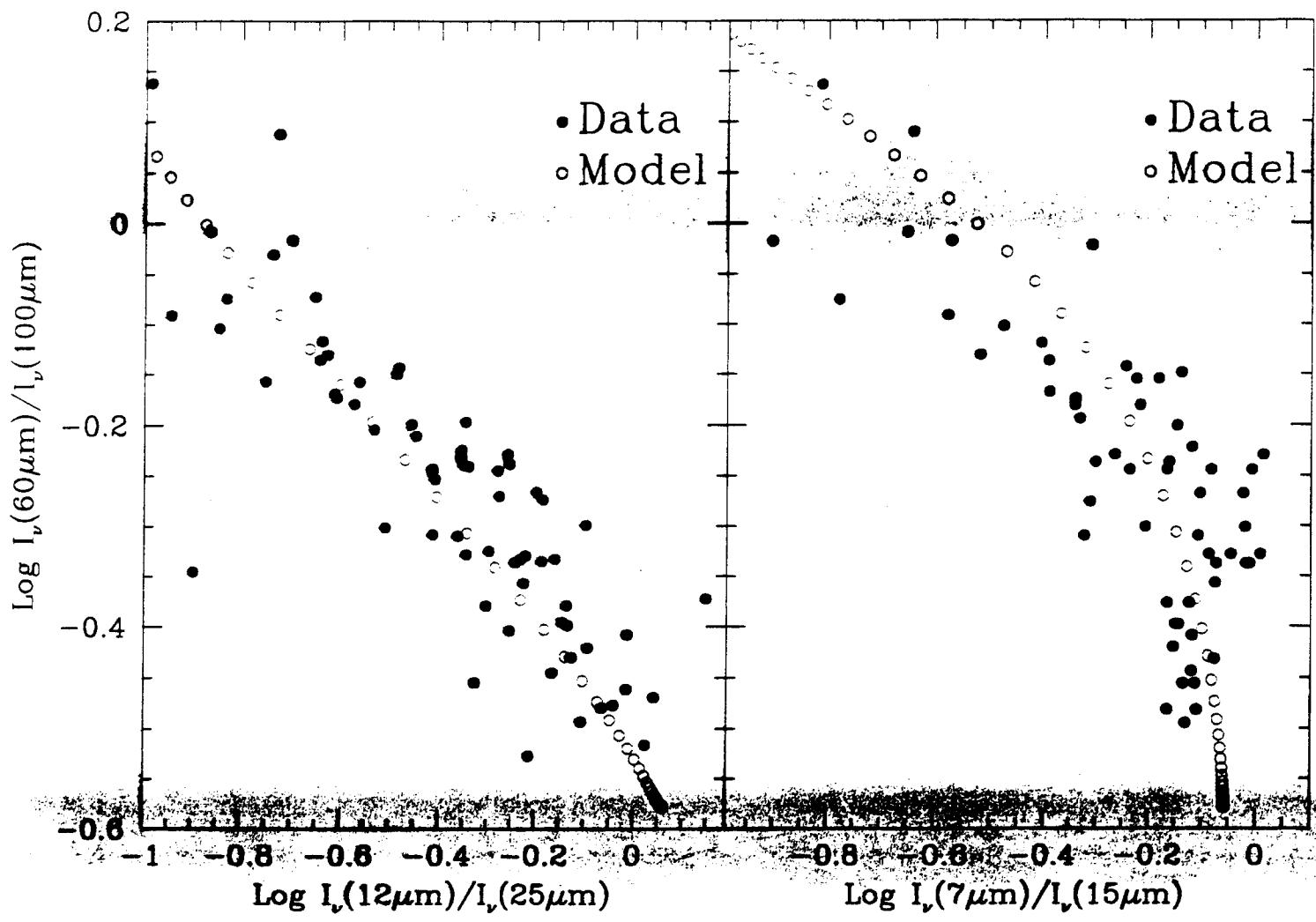
Emission for heating intensity $U \sim$ local ISRF



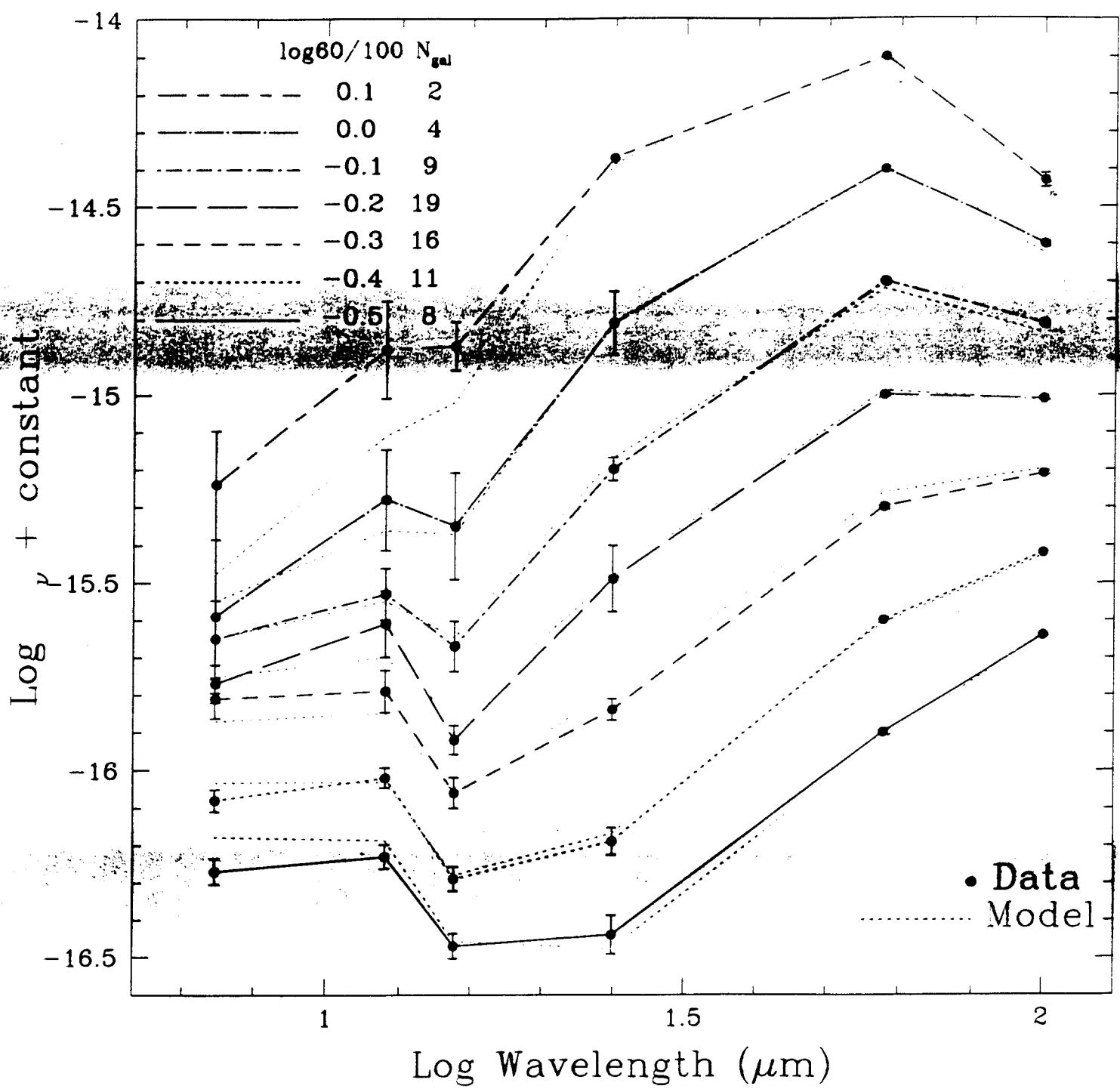


Model Normal Galaxy SEDs





Dec 3 10:47:40 1999



Dec 3 10:47:07 1999

Conclusions

Developed updated IR SED model for normal star-forming galaxies

Constrained by IRAS & ISO photometry and spectroscopy.

$N = 69$ galaxies

Spectra constructed from 3-component dust emission

Sequence of spectra \rightarrow Sequence in heated dust distrib.

Good fit to the empirical sequence parametrized by $\frac{I_\nu(60\mu\text{m})}{I_\nu(100\mu\text{m})}$

Few parameters

Long wavelength trends consistent with submm data

Many useful **applications**

IR energy budget

Predict high-redshift color-color behavior

Provide templates for cosmological studies